

PATENT

Attorney Docket No. A-71184/DJB/VEJ
Attorney Matter No. 461124-00020
Application No. 09/980,956

REMARKS

Reconsideration of this Application is respectfully requested. Upon entry of the foregoing amendments, claims 2-13, 15-20, 22, 23 and 25-29 are pending in the application, with claims 15, 25 and 29 being the independent claims. Claims 22, 23, and 29 are allowed. Claims 1, 14, 21, and 24 have been canceled without prejudice or disclaimer. Support for the subject matter of the amended claims is contained in the application as originally filed. Because the foregoing changes introduce no new matter, their entry is respectfully requested.

Based on the above Amendment and the following Remarks, Applicant respectfully requests that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Rejections under 35 U.S.C. § 102 and 103***Claims 5, 6, 17-19, and 25***

The Examiner has rejected claims 5, 6, 17-19, and 25 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Application No. 5,942,349 and International Publication No. WO 96/28855, both to Badwal et al. (collectively "Badwal"). The Examiner has rejected claim 25 over Badwal on the basis that "layer of copper" can read onto a layer of a chromia protection material comprising M, Cr spinel optionally doped with Cu and/or other metals where M is Mn, Fe, Co or Ni. Applicant respectfully disagrees with this interpretation and reasserts the previous arguments herein. However, in the interest of expediency, claim 25 has been amended to recite "a layer *consisting* of copper" as suggested by the Examiner at paragraph 6 on page 6 of the office action mailed January 25, 2006, to overcome the rejection based on Badwal.

Applicant respectfully submits that Badwal, taken individually or combined, does not anticipate independent claim 25. Applicant submits that claims 5, 6, and 17-19, which depend from claim 25, are allowable over the cited art for at least the same reasons noted above.

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Application No. 09/980,956***Claims 6,11-13, and 25***

The Examiner has rejected claims 6, 11-13, and 25 under 35 U.S.C. § 102(b) as being anticipated by German Publication No. DE 29807832 ("DE 29807832"). Applicant respectfully submits that DE 29807832 fails to teach or suggest the gas separator member as called for by amended claim 25.

First, as noted by the Examiner, the gas separator plate in DE 29807832 applies to use with a solid oxide fuel cell system and comprises a chromium-containing substrate and a layer of alumina on the cathode side of the substrate, with the alumina layer optionally containing at least one further chemical element for increasing the electrical conductivity of the layer. Fourteen elements are exemplified for this purpose, including copper. DE 29807832, however, discloses an alumina layer containing at least 90% by weight of aluminium. *See* column 6, line 28 of the translation filed by Applicant on June 10, 2005. In contrast, amended claim 25 calls for at least 50% by weight of Cu. Accordingly, DE 29807832 teaches away from the present invention because the reference discloses that the alumina layer can have at most 10% weight of copper.

Furthermore, allowing for oxygen, DE 29807832 suggests the amount of copper is less than 10% by weight. As such, the teachings of DE 29807832 certainly prohibit the use of "a layer consisting of copper or of a copper-based alloy containing *at least 50 wt% Cu*" as recited by claim 25.

Applicant also submits that DE 29807832 fails to disclose "a layer of oxidation-resistant material on the cathode side of the copper or copper-based alloy layer" as called for by amended claim 25. DE 29807832 discloses the copper or other electrically-conductive element in the alumina layer specifically to provide electrical conductivity between the substrate of the gas separator member and the adjacent cathode. The layer of alumina containing the electrically-conductivity element is in contact with the cathode. Therefore, the structure of the gas separator member disclosed by DE 29807832 is different than that of amended claim 25.

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For at least these reasons, Applicant respectfully submits that DE 29807832 does not anticipate independent claim 25. Applicant submits that claims 6 and 11-13, which depend from claim 25, are allowable over the cited art for at least the same reasons as claim 25 noted above.

Claims 2-10, 20, 25, and 26

The Examiner has rejected claims 2-7, 20, 25, and 26 under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,232,792 to Reznikov ("Reznikov") in view of International Patent Publication No. WO 97/35349 ("WO 97/35349"). The Examiner has also rejected claims 8-10 under 35 U.S.C. § 103 as being unpatentable over Reznikov in view of WO 97/35349 and further in view of WO 99/13522. Reznikov and WO 97/35349, taken individually or combined, fail to teach or suggest the protective layer of the present invention including a layer of oxidation-resistant material on the cathode side of the copper or copper-based alloy layer, as called for claim 25.

The Examiner contends that Reznikov is directed to a solid oxide fuel cell. *See* Office Action mailed January 25, 2005, page 4. Applicant respectfully disagrees. While Reznikov does suggest at column 4, line 63 that the gas separator plate may be used with solid oxide fuel cells, Reznikov is directed to use with a molten carbonate fuel cell system. *See* Reznikov column 3, lines 31-34. The difference between Reznikov and the present invention is most important when the separator plates are intended to be used in internally reformed fuel cell stacks. *See* Reznikov at column 5, lines 4 to 8.

In fact, the separator plate disclosed by Reznikov can not be used in a solid oxide fuel cell system that is internally reformed (natural gas and/or methane converted to hydrogen within the fuel cell, for use as the fuel gas) for exactly the reason explicitly mentioned at page 5, lines 11 to 22 of the present application. In essence, the present invention calls for copper as a gas separator material for solid oxide fuel cells for cost and thermal management reasons. In particular, copper has a higher thermal conductivity than steel so that thinner layers of the metal can be used to achieve the same conductivity. However, at the operating temperature of an SOFC, for example greater than 750°C, copper is not stable and oxidizes in air. Thus, a layer of

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oxidation-resistant material, such as stainless steel or alumina, is required on the cathode side. Furthermore, since copper poisons the internal reforming reaction on the anode side of a solid oxide fuel cell, a protective layer is required to prevent volatile copper compounds forming and reaching the anode side.

Furthermore, Reznikov is directed to an entirely different application and objective. Applicant submits that there is no teaching or suggestion to modify or use Reznikov in an internally reformed solid oxide fuel cell system because the gas separator of Reznikov is not in fact suitable in such applications. The gas separator disclosed by the reference is configured for use with a molten carbonate fuel cell system, which operates at a maximum temperature of 700°C. Similar to DE 19523637, nickel or copper is provided on the anode side of a stainless steel substrate not for its advantageous conductivity properties over stainless steel but rather to protect the stainless steel of the substrate from the aggressive anode-side atmosphere that is present in the molten carbonate fuel cells.

Also, as in DE 19523637, there is no suggestion of a protective layer on the anode side of the nickel or copper layer since a protective layer is not required in a molten carbonate fuel cell system. Applicant further submits that Reznikov fails to recognize or suggest the problem recognized by the present invention of using copper *without a protective layer in an internally reformed solid oxide fuel cell system*.

The Examiner argues that this deficiency is overcome by reading Reznikov in the light of Applicant's own publication, WO 97/35349. WO 97/35349 discloses a specific coating system on the anode side of a chromium-containing substrate of a gas separator to prevent chromium oxides forming at the anode-side surface of the separator. In Reznikov, the nickel or copper layer is the protective layer. Thus, there is no motivation or suggestion to provide a further protective layer over the nickel or copper layer as taught by Reznikov.

In contrast to Examiner's contention, Applicant submits that one skilled in the art would not be motivated to modify Reznikov by adding a protective layer to prevent oxidation of the nickel or copper layer because oxidation of copper (or nickel) on the anode side (i.e., fuel side)

AMENDMENT AND REPLY

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of a solid oxide fuel cell is not an issue – it does not occur. In contrast, the present invention calls for an oxidation-resistant material on the cathode side (i.e., air side). What is required on the anode side of the copper-based gas separator of the invention is a protective layer to prevent Cu vapor from escaping from the anode side of the gas separator at the operating temperature of the solid oxide fuel cell assembly. As noted previously, Reznikov is directed to an entirely different problem.

Furthermore, there is no teaching or suggestion in WO 97/35349 to provide an oxidation-resistant coating comprising an outer layer of Ni and/or a noble metal, except Ag and an intermediate layer comprising Nb, Ta, Ag or alloys thereof, to prevent Cu vapor from escaping as called for by the present invention.

For at least these reasons, Applicant respectfully submits that Reznikov and WO 97/35349, taken individually or combined, do not render obvious independent claim 25. Applicant submits that claims 2-7, 8-10, 20, and 26, which depend from claim 25, are allowable over the cited art for at least the same reasons noted above.

Allowable Subject Matter

Applicant thanks the Examiner for indicating that claims 15, 16, 27, and 28 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant respectfully submits that claim 15 has been rewritten in independent form to include the limitations of claim 25 and is thus allowable. Application further submits that claims 16, 27 and 28 are likewise allowable by virtue of their dependence on rewritten claim 15.

CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action

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and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided below.

The Commissioner is hereby authorized to charge any underpayment of fees associated with this communication, including any necessary fees for extension of time or additional claims, and/or credit any overpayment to Deposit Account No. 50-2319 (Order No. 461124-00020; Docket No. A-71184/DJB/VEJ).

Prompt and favorable consideration of this Amendment and Response is respectfully requested.

Respectfully submitted,

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Date: April 19, 2006

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